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ABSTRACT

This report presents selected demcgraphic and employment characteristics of recent bachelor's- and master's-degree recipients in science and engineering (S/E). The findings reported are based upon the results of a survey of the 1973-74 and 1974-75 graduating classes conducted in 1976. Surveys of new entrants to science and engineering constitute one of the elements used by the Foundation in delineating the total S/E population in the United States. Information on scientists and engineers who were in the S/E labor force at the time of the 1970 Decennial Census is provided by Surveys of Experienced Scientists and Engineers; characteristics of doctoral scientists and engineers are obtained by surveys of a sample selected from the Doctoral Roster; and the New Entrants Surveys furnish information on those who have entered the S/E labor force since 1970. (Author)

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Reviews OF DATA ON SCIENCE RESOURCES

NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C. NSF 78-310 No. 32, JUNE 1978

Employment Patterns of Recent Entrants Into Science and Engineering

This report presents selected demographic and employment characteristics of recent bachelor's- and master's-degree recipients in science and engineering (S/E). The findings reported are based upon the results of a survey of the 1973-74 and 1974-75 graduating classes conducted in 1976. Surveys of new entrants to science and engineering constitute one of the elements used by the Foundation in delineating the total S/E population in the United States. Information on scientists and engineers who were in the S/E labor force at the time of the 1970 Decennial Census is provided by Surveys of Experienced Scientists and Engineers; characteristics of doctoral scientists and engineers are obtained by surveys of a sample selected from the Doctoral Roster; and the New Entrants Surveys furnish information on those who have entered the S/E labor force since 1970.

Assessment Highlights

- The labor force participation rate for recent S/E baccalaureates was 95 percent. The rate for women graduates was 91 percent, which was considerably higher than the 63-percent level for women at all age levels with four years of college. Clearly, women graduates do seek employment and are a significant factor in the supply of new S/E's.
- Unemployment for these same graduates, measured one to two years after graduation, was 8.5 percent. The higher unemployment rate for women (10.9 percent) may be related to the fields of study in which they major. Two-thirds of the women S/E baccalaureates received their degrees in the social sciences where the unemployment rate was 11.4 percent. In contrast, only 1 percent of the women majored in engineering (compared to 37 percent of the men) which had an unemployment rate of 3.5 percent.
- Nearly one-fourth of the bachelor's recipients went into graduate school as full-time students. This proportion was three times greater than the 8-percent level of 1958 graduates. This increase is probably related to the substantially greater proportion of master's-degree recipients who obtain S/E employment. Three out of four master's obtain such employment compared to less than one-half of the bachelor's.
- The variables most highly correlated with educationally related employment are (1) field of degree—engineering graduates have high probabilities of finding S/E employment whereas the opposite is true for social science majors; (2) previous work experience—a person who has not previously worked is less likely to obtain a job related to his or her education; (3) level of degree—if the graduate has a master's degree the probability increases; and, (4) the graduate primarily engaged in research has a greater likelihood of working in a field related to his or her degree.
- Approximately one-third of all S/E baccalaureate recipients who did not become full-time graduate students are employed in a job related to their broad field of study. With few exceptions, such as engineering and computer sciences, the results of this study indicate that there is an adequate supply of S/E's and an oversupply in some fields.

Prepared in the Demographic Studies Group, Division of Science Resources Studies

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Introduction

Data regarding new entrants into science and engineering are of particular interest for several reasons. The unemployment patterns of new scientists and engineers are significant indicators of the current supply-demand balance. The fluctuation or variance in employment patterns and characteristics of new scientists and engineers are substantial and, therefore, useful measures in determining the extent to which the economy is able to utilize the personnel trained and schooled in the methods of science. Demographic and employment characteristics of new scientists and engineers are of interest to administrators involved in affirmative action programs. These studies provide information to educators and to students that is relevant to a number of educational and career choices which in turn affect the supply of scientists and engineers.

This report presents the results of an examination of baccalaureate- and master's-degree recipients in science and engineering from the 1974 and 1975 graduating classes. These data have been analyzed with respect to postgraduate student status, entrance into the labor force, and success in gaining employment in 1976.

In the two combined graduating classes of 1974 and 1975, American universities and colleges had produced about 615,000 bachelor's- and 108,000 master's-degree recipients in S/E fields.[1] By summer 1976, about one-quarter of the bachelor's degree-holders and one-fifth of the master's degree-holders were enrolled full time in graduate-degree programs. In both cases, full-time graduate students outnumbered part-time graduate students in the ratio of about eight to five.

Graduate school status	*Bachelor's degree*	*Master's degree*
Total degree recipients .	614,900	108,500
Full-time graduate students .	144,600	20,600
Part-time graduate students .	90,100	12,300
Nongraduate students	380,200	75,500

Note: Detail may not add to total because of rounding.

The status of individuals not enrolled in full-time graduate-degree programs provides the principal framework for this analysis which is focused on the extent to which this group entered the labor force, their success in finding employment, and the characteristics of such employment. Specifically, a model incorporating sequential probabilities and multi-variate analyses was used to address the following questions that constitute a sequence in which each stage has an identifiable probability:

Did the graduate look for a job?
Did he or she get a job?
Was the job in the sciences?
Was the job in his or her field?

Each of these issues is examined on the basis of the numerical data presented in tables A and B which reflect selected employment characteristics by field of degree and sex for both bachelor's- and master's-degree recipients. In addition, multivariate analyses incorporating these and other variables were conducted in an attempt to explain observed variation.

Entrants into the Labor Force

A matter of serious concern to national and institutional planners, as well as to students, is the extent to which S/E college graduates enter the labor force and are then able to find employment.

In 1976 the number of 1974 and 1975 baccalaureate recipients who were not pursuing graduate studies on a full-time basis was about 470,300;[2] they represented 76 percent of all S/E baccalaureates. The overall labor force participation rate of this combined group was 95 percent. For this group, entry into the labor force was high for both men and women, although the rate for men (96 percent) was slightly greater than that of women (91 percent). No great variability among fields of degree was evident, although labor force participation rates were highest among engineers.

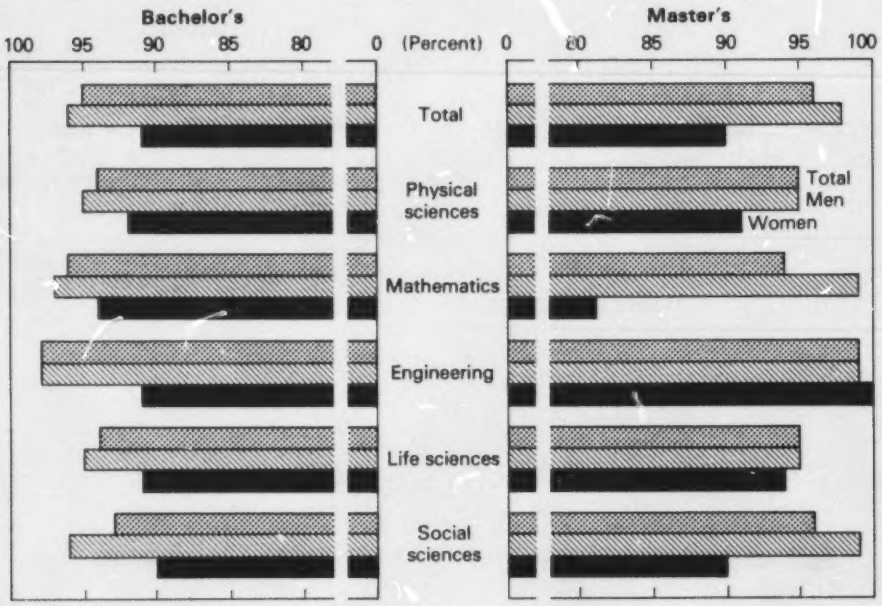
Labor force participation rates of the similar 1974 and 1975 master's-degree group were not substantially different from those of new undergraduate degree-holders; the overall rate of 96 percent was only slightly higher than that for bachelor's-degree recipients and this slight increase was evident principally among men (chart 1).

Labor force participation was one of the several characteristics subjected to multivariate analysis techniques. The general purpose of such techniques is to establish and analyze the relationships between a dependent or criterion variable, in this case labor force participation, and a set of independent or predictor variables such as field,

[1] These figures include about 15,000 bachelor's-degree and 400 master's-degree recipients in engineering technologies.

[2] Full-time graduate students are excluded from the ensuing analysis.

Chart 1. Labor force participation rates of 1974 and 1975 S/E-degree recipients[a] by field of degree and sex: 1976



[a]Excludes those enrolled full time in graduate school.
SOURCE: National Science Foundation

race, sex, etc. In the analytical model used, a stepwise multiple regression program was conducted based upon data obtained from the New Entrants Survey of 1976. Although multiple regression techniques have a number of uses, the principal purpose in this study was to identify those variables that correlated highest with a specific characteristic. Thus, in the case of labor force participation, demographic and educational variables were analyzed including sex, age, field of degree, year of degree, level of degree, and race. In this instance, the analyses showed that no substantial correlation exists between any of these variables and labor force participation. Thus, while some differences in labor force participation rates among various groups were observed, no clear pattern regarding this matter is predictable on the basis of the multiple regression analysis performed.

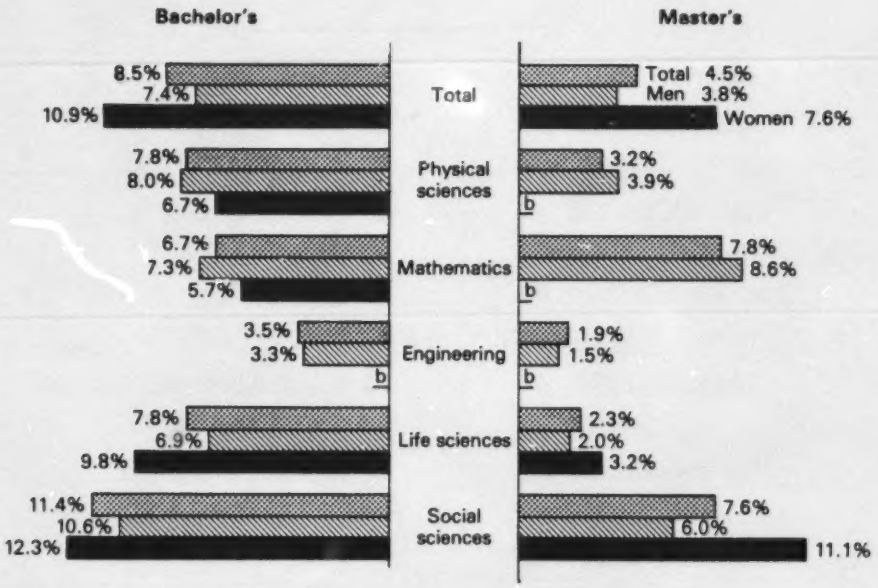
Unemployment Rates

In 1976 the unemployment rate of bachelor's degree-holders in science and engineering, from the combined 1974 and 1975 graduating classes who were not enrolled full time in graduate school, was 8.5 percent. The unemployment rate for women (10.9 percent) was higher than that for men (7.4 percent). The higher rate for women was not, however, the case among all fields of science. For example, unemployment rates for women in the physical and mathematical sciences were, in general, *lower* than those of men. Among life and social scientists, however, the unemployment rates for women were higher (chart 2).

The high, overall unemployment rate in the social sciences coupled with the relatively large number of women in these fields appears to have had a pronounced effect on the total unemployment rate for women. A recurring theme is that women are more heavily concentrated in fields that have higher unemployment rates for both sexes. In this instance, the general category of social science incorporates psychology. A large fraction of men, on the other hand, received a degree in engineering where prospects for employment are better (chart 3).

Unemployment rates among master's degree-holders were lower in all fields except mathematics. The overall unemployment rate and that for men only were about one-half of the rates for baccalaureate recipients. Again, however, the major factor in the difference between men's and

Chart 2. Unemployment rates of 1974 and 1975 S/E-degree recipients[a] by field of degree and sex: 1976

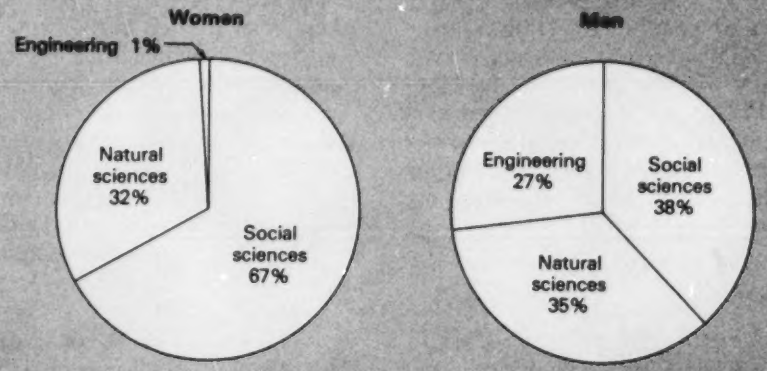


[a]Excludes those enrolled full time in graduate school.
[b]No unemployment rate computed for groups with less than 2,500 in labor force.
SOURCE: National Science Foundation

women's unemployment rates appears to be the low unemployment rate for engineers, who are predominantly men, and the higher unemployment rates for social scientists who include a large fraction of the female master's graduates (table B).

Multiple regression analyses of the relationships between unemployment and other variables were also conducted. As with labor force participation, the independent variables consisted of sex; age; field, year, and level of degree; and race. Again the

Chart 3. S/E bachelor degree-holders[a] by field of degree and sex: 1974 and 1975



[a]Combined 1974 and 1975 graduating classes excluding those enrolled full time in graduate school.

results did not provide a very substantial explanation of the variation in employment rates, yielding a multiple correlation coefficient of 0.2.

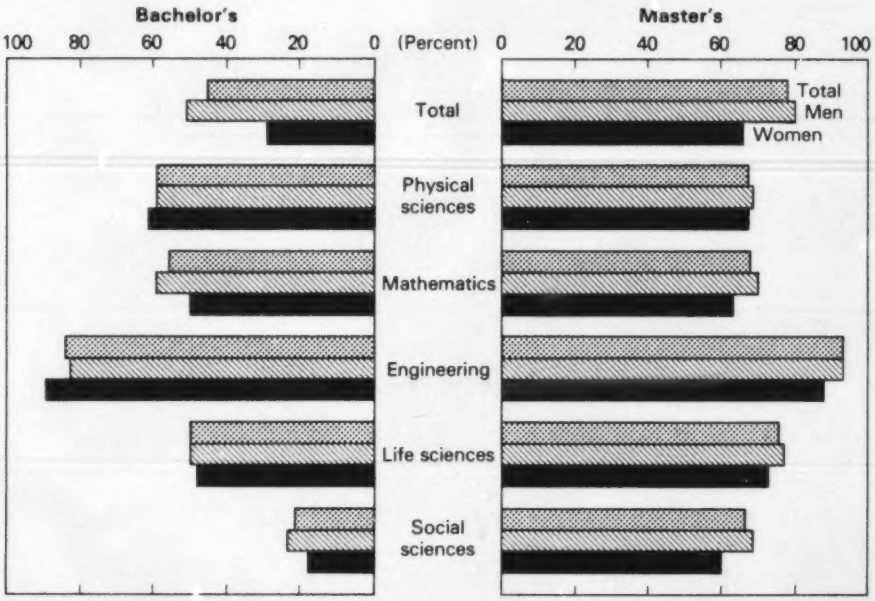
With the above information it is posssible to reply to the question, "Do new S/E graduates find jobs?" The answer is, they find jobs, but with some difficulty. The unemployment rate for new baccalaureate recipients was 8.5 percent; for master's recipients, 4.5 percent. Thus, the unemployment rates for new baccalaureate-holders in science and engineering was higher than the national average[1] and about twice that of master's degree-holders. But again, although variability in employment rates among groups was observed, little explanation of the variance in unemployment rates was provided by the multiple regression analysis conducted.

Employment in Science and Engineering

Employment in nonscience/engineering is sometimes used as a measure of the underemployment of scientists and engineers, although there is a question whether many employers consider baccalaureates in some fields employable as scientists. Of the 406,800 men and women who had received S/E bachelor's degrees in 1974 and 1975, less than one-half were employed in S/E-related positions. Differences between men and women were quite pronounced: about one-half of the men in this group were in S/E employment as compared with less than one-third of the women. But the extent of bachelor's degree-holders in S/E employment varied considerably among fields of science, and in some fields the fraction of women working in S/E jobs was comparable to that of men. Considering field alone, however, individuals with degrees in the natural sciences and in engineering, were, in general, more frequently employed in S/E jobs than were those who had received degrees in the social sciences, including psychology (chart 4). In light of the information presented in chart 3, it is again apparent that the employment difficulties encountered by social scientists at this degree level has a greater impact on women because of their concentration in this area. In contrast, the high market demand for individuals skilled in engineering was evident on the basis of this measure; about

[1] The annual average unemployment rate in the United States for 1976, irrespective of educational attainment and experience, was 7.7 percent.

Chart 4. Percent of employed 1974 and 1975 S/E-degree recipients[a] in S/E jobs by field of degree and sex: 1976



[a]Excludes those enrolled full time in graduate school.
SOURCE: National Science Foundation

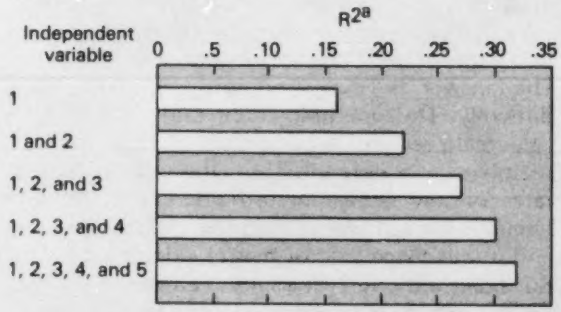
six out of seven such people were employed in science and enginering.

Employment in S/E jobs at the master's-degree level was much greater than that of bachelor's degree-holders. Overall, more than three-fourths of employed master's degree-holders were working in S/E jobs as compared with about 45 percent of bachelor's recipients.[4]

This increase was evident among men but particularly so among women who more than doubled in proportion to their numbers. Thus, it would appear that the master's degree has a pronounced effect in respect to the ability to gain employment in S/E activities, particularly among women.

Multivariate analysis of S/E employment identified stronger explanatory variables. The independent variables in this analysis consisted of sex; age; field, year, and level of degree; race; previous work experience; and type of employer. The strongest sources of explanation for the variation in S/E employment were found to be categories of field of degree, years of work experience, level of degree, and race. Individuals with degrees in the social sciences were likely not to find S/E employment, as were those with no previous work experience. Conversely, an engineering degree has a positive relationship with S/E employment. The analysis confirms further that individuals with master's degrees versus baccalaureate degrees in science and engineering are more likely to be employed in an S/E occupation as are Whites versus racial minorities. These discrete independent variables account for about one-third (R^2 = .32) of the variation in S/E employment, when considered jointly (chart 5).

Chart 5. Multivariate analysis of employment in S/E jobs



No.	Variable
1.	Social science degree (negative correlation)
2.	White racial origin
3.	No previous work experience (negative correlation)
4.	Engineering degree
5.	Master's degree

[a]Proportion of variance in outcome which is explained by independent variables in step-wise progression.
SOURCE: National Science Foundation.

Employment in Major Fields of Study

It is frequently held that in many fields of science the bachelor's-degree recipient is not considered fully qualified for professional employment in that field.[5] Employment data regarding the 1974 and 1975 college graduates are generally consistent with this notion; of more than 400,000 men and women who were employed in 1976, less than three-eighths (36 percent) were employed in the broad areas represented by fields of study. In this regard, the proportion of men so employed was about twice that of women (chart 6).

But although baccalaureate recipients were not generally employed in their field of study, there were exceptions in some specific fields—notably engineering, computer science, and to a lesser extent, chemistry and agricultural science. In engineering and computer science, almost four-fifths of the baccalaureate recipients employed were working in their own fields; in chemistry and agricultural science almost 50 percent. In other fields, the proportions so employed were much smaller, particularly in psychology and the social sciences (table A).

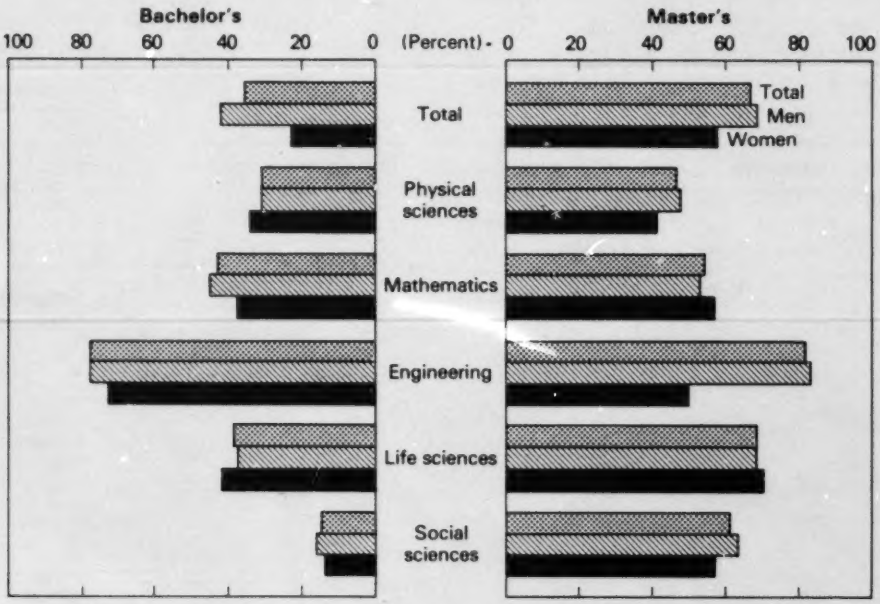
The ability to find professional employment in one's chosen field of study is substantially enhanced by receipt of a master's degree. Thus, among master's-degree recipients, over two-thirds were so employed. This increase was particularly evident among women, of whom almost three-fifths were working in their field of study as compared with less than one-quarter of the female baccalaureate recipients.

A multiple regression analysis of the basis for employment within one's field of study was also conducted. Because of the large number of specific field categories, a grouping of fields was found to be necessary. For purposes of this analysis, both the fields of degree and fields of employment were classified in terms of the following general

[4] By comparison, about 95 percent of new S/E doctorates are employed in science and engineering.

[5] In the absence of absolute qualification standards, however, hiring practices with respect to educational attainment are influenced by labor market supply and demand conditions.

Chart 6. Percent of employed 1974 and 1975 S/E-degree recipients[a] working in field of degree by sex: 1976

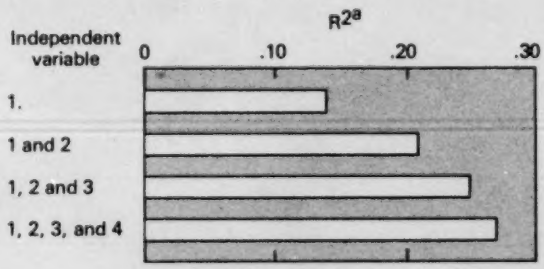


[a]Excludes those enrolled full time in graduate school.
SOURCE: National Science Foundation

categories: Physical sciences; mathematics, including computer science; engineering; life sciences; and social sciences, including psychology. The independent variables included in this analysis consisted of sex, race, field, year and level of degree, years of work experience, age, type of employer, primary work activity, and status of support by Federal funds.

The analysis reveals that the most potent explanation of variation in employment within one's broad field of study is provided by field of degree, work experience, and primary work activity. An engineering degree was found to correlate highest and positively with the outcome while a negative relationship was found to exist between the dependent variable and no previous work experience. Positive relationships with the outcome were also exhibited by individuals in research and development and master's degree-holders. About 27 percent of the variation could be explained on the basis of these independent variables, collectively (chart 7).

Chart 7. Multivariate analysis of employment in field of study



No.	Variable
1.	Engineering degree
2.	No previous work experience (negative correlation)
3.	Primarily engaged in R&D
4.	Masters degree

[a]Proportion of variance in outcome which is explained by independent variables in step-wise progression.
SOURCE: National Science Foundation

The employment model of S/E graduates is summarized in chart 8. The percentages provided reflect probabilities of a "yes" answer to the questions posed. It can be seen that approximately one-third of the baccalaureates and two-thirds of the master's graduates in science and engineering who gained employment obtained a job closely related to their field of training. The difference in the employment patterns by field of degree has been noted and its importance has been particularly stressed in the multivariate analyses where engineering and other selected fields of study have been especially related to the outcomes.

Chart 8. Employment model for S/E-degree recipients

	Yes
Did the graduate look for a job?	Bachelor's — 94.5% Master's — 96.5%
Did he or she get a job?	Bachelor's — 91.5% Master's — 95.5%
Was job in science & engineering?	Bachelor's — 44.7% Master's — 77.5%
Was the job in his or her field?	Bachelor's — 36.1% Master's — 67.1%

SOURCE: National Science Foundation

Detailed Statistical Tables

TABLE A.–SELECTED EMPLOYMENT CHARACTERISTICS OF 1974 AND 1975 BACHELOR'S-DEGREE RECIPIENTS[1] IN SCIENCE AND ENGINEERING BY FIELD: 1976

Field of study	Total			Labor force			Total employed			Employed in S/E			Employed in field		
	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women
Total	470,300	318,100	152,200	444,600	306,300	138,300	406,800	283,600	123,200	181,900	145,700	36,200	146,800	118,200	28,600
Physical Sciences	25,200	20,700	4,500	23,800	19,600	4,200	21,900	18,100	3,800	12,900	10,700	2,300	6,800	5,600	1,300
Chemistry	11,100	8,700	2,400	10,400	8,200	2,200	9,500	7,500	2,100	6,400	4,900	1,500	4,400	3,300	1,100
Physics/Astronomy	4,200	3,900	300	4,000	3,700	300	3,600	3,400	200	2,300	2,200	200	800	800	(2)
Environmental Sciences	5,100	4,300	800	4,900	4,100	800	4,600	3,800	700	2,700	2,300	400	1,300	1,200	100
Other Physical Sciences	4,800	3,800	1,000	4,500	3,600	900	4,200	3,400	800	1,500	1,300	200	300	300	100
Mathematical Sciences	42,900	27,600	15,400	41,200	26,700	14,500	38,400	24,800	13,600	21,600	14,700	6,800	16,300	11,100	5,200
Mathematics	33,700	20,600	13,100	32,100	19,800	12,300	29,400	18,000	11,400	13,500	8,700	4,800	9,200	5,800	3,400
Computer Sciences	9,200	7,000	2,300	9,100	6,900	2,200	9,000	6,800	2,200	8,100	6,100	2,000	7,100	5,300	1,800
Engineering	87,800	85,600	2,200	86,100	84,100	2,000	83,200	81,400	1,800	69,400	67,800	1,600	64,600	63,300	1,300
Life Sciences	93,200	64,600	28,600	87,300	61,300	26,000	80,500	57,000	23,400	40,000	28,600	11,300	31,600	21,800	9,800
Biology	65,600	39,800	25,800	60,800	37,400	23,400	55,500	34,300	21,200	26,100	16,200	9,900	19,700	11,200	8,500
Agricultural Sciences	27,600	24,800	2,800	26,500	23,900	2,600	25,000	22,700	2,200	13,800	12,400	1,400	11,900	10,600	1,300
Social Sciences	221,200	119,600	101,500	206,200	114,500	91,800	182,800	102,300	80,400	37,900	23,800	14,200	27,300	16,300	11,000
Psychology	79,000	35,900	43,100	73,400	34,500	38,900	64,100	30,200	33,900	15,600	9,300	6,300	11,000	6,300	4,700
Economics	21,200	17,600	3,600	20,400	17,000	3,500	18,700	15,400	3,300	3,700	3,400	300	2,000	1,900	100
Sociology/Anthropology	67,400	27,200	40,100	62,000	25,500	36,500	54,400	22,600	31,700	10,400	4,900	5,600	8,300	3,700	4,600
Other Social Sciences	53,600	38,900	14,700	50,400	37,500	12,900	45,600	34,100	11,500	8,200	6,200	2,000	6,000	4,400	1,600

[1] Excludes those enrolled full time in graduate school in 1976.
[2] Less than 50.

NOTE: Detail may not add to totals because of rounding.

SOURCE: National Science Foundation.

TABLE B.—SELECTED EMPLOYMENT CHARACTERISTICS OF 1974 AND 1975 MASTER'S-DEGREE RECIPIENTS[1] IN SCIENCE AND ENGINEERING BY FIELD: 1976

Field of study	Total			Labor force			Total employed			Employed in S/E			Employed in field		
	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women
Total	37,900	70,200	17,700	84,800	68,900	15,900	81,000	66,300	14,700	62,700	53,100	9,700	54,300	45,800	8,600
Physical Sciences	8,400	6,900	1,500	7,800	6,500	1,400	7,700	6,200	1,400	5,200	4,200	1,000	3,500	3,100	600
Chemistry	3,300	2,400	800	3,000	2,300	700	3,000	2,300	700	2,400	1,800	600	2,000	1,600	400
Physics/Astronomy	1,700	1,700	(2)	1,500	1,500	(2)	1,400	1,400	(2)	1,000	1,000	(2)	600	600	(2)
Environmental Sciences	1,400	1,200	300	1,400	1,200	300	1,400	1,100	300	1,200	1,000	200	700	700	100
Other Physical Sciences	2,000	1,600	400	1,900	1,500	400	1,900	1,400	400	600	400	200	200	200	100
Mathematical Sciences	11,200	8,500	2,700	10,600	8,400	2,200	9,800	7,600	2,000	6,700	5,300	1,300	5,300	4,100	1,200
Mathematics	7,000	5,000	2,000	6,400	4,900	1,600	5,700	4,200	1,400	3,200	2,300	800	2,600	1,900	700
Computer Sciences	4,200	3,500	700	4,200	3,500	600	4,100	3,400	600	3,500	3,000	500	2,700	2,200	500
Engineering	28,200	27,300	900	28,000	27,100	900	27,500	26,700	800	25,600	24,900	700	22,500	22,100	400
Life Sciences	14,300	10,600	3,800	13,600	10,000	3,500	13,300	9,800	3,500	10,100	7,600	2,500	9,100	6,600	2,400
Biology	10,300	7,000	3,300	9,800	6,700	3,100	9,600	6,600	3,000	7,200	4,900	2,300	6,500	4,300	2,200
Agricultural Sciences	4,000	3,600	500	3,800	3,300	500	3,700	3,200	500	2,900	2,700	200	2,600	2,300	200
Social Sciences	25,800	17,100	8,800	24,700	16,900	7,800	22,800	15,900	7,100	15,200	11,000	4,200	13,900	9,900	4,000
Psychology	10,000	6,100	3,900	9,700	6,100	3,600	9,200	6,000	3,300	7,000	5,000	1,900	6,600	4,800	1,800
Economics	3,500	2,900	600	3,300	2,900	400	3,300	2,900	400	2,200	1,800	400	1,800	1,400	400
Sociology/Anthropology	5,000	2,800	2,200	4,800	2,800	2,000	4,000	2,200	1,900	2,900	1,700	1,200	2,600	1,400	1,200
Other Social Sciences	7,300	5,300	2,100	6,900	5,100	1,900	6,300	4,800	1,500	3,100	2,500	700	2,900	2,300	600

[1] Excludes those enrolled full time in graduate school in 1976.
[2] Less than 50.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation

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